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The Use of Aquatic Plants as Feed for *Tilapia nilotica* in Floating Cages

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ABSTRACT

Three kinds of aquatic plants, namely, *Hydrilla verticillata*, *Lemna minor*, and *Chara sp.* were used as feed for the *Tilapia nilotica* reared in floating cages at three levels of stocking densities: 5, 15, and 45 fishes per cage.

Results of the study showed that *Lemna minor* gave the best effect on growth rate of the fish in every level of stocking density.

Feed conversion rate ranged from 19 to 33; *Lemna minor* was the lowest (33:1), while *Chara sp.* was the highest (19:1).

INTRODUCTION

Tilapia nilotica was introduced in 1969, from Taiwan, into Indonesia by the Research Institute for Inland Fisheries of Indonesia. It has been transplanted to 21 provinces in the country (Hardjanulia and Djajadiredja, 1977).

The Government of Indonesia has chosen this species as one of the commodities to be promoted for a non-commercial fish programme (Soesanto, 1975). Some hatcheries have taken part to produce seed of Nila (local name of *T. nilotica*) to be distributed to local people.

Rearing *T. nilotica* in impounding net has also been tried by the Inland Fisheries Research Station in Lake Jatiluhur, West Java. Bamboo cage culture and pen culture of *T. nilotica* has been done on an experimental basis by the Aquaculture Department, Faculty of Agriculture, Padjadjaran University, in Curug water-reservoir, West Java.

The use of cage for culturing common carp (*Cyprinus carpio*) is very popular especially in West Java, and since the last world war, has become an established industry (Djajadiredja and Jangkaru, 1977).

The use of aquatic plants as feed for *T. nilotica* in floating cages is discussed in this paper.

MATERIALS AND METHODS

The experiment was conducted from March to June 1978 at Curug water reservoir, Kecamatan of Klari, Kabupaten of Karawang, West Java Province. The water temperature ranged from 28.0 to 31.5°C, and the pH ranged from 6.0 to 7.5.

The cages used for rearing the fish were 2 m³ (2 x 1 x 1 m) made of split bamboo nailed to a wooden frame. Inside the cage, polyethylene net with mesh size of 0.3 cm was used for doubling the cage. This net could be easily pulled out for sampling purposes. Supported by bamboo poles, each cage was floated in the water to get a water volume of 1 m³. The average depth of water was 1.5 m. The total number of cages used in this experiment was 27, separated into three blocks of nine cages. The feed treatments were of three levels: *Hydrilla verticillata*, *Lemna minor*, and *Chara sp.*, while the stocking densities were also of three levels: 5, 15, and 45 fishes per cage. The aquatic plants as feed were given every day at a quantity of at least 30 percent of the total weight of the stock.

The *Tilapia nilotica* used in this experiment had an average weight of 170 g.

The total number of feed consumed by the fish was determined by subtracting the unconsumed feed from the total number of feed given.

RESULTS AND DISCUSSION

Under cage culture condition, the use of aquatic plants as feed for *T. nilotica* was relatively effective. The effect on growth rate of the fish is shown in Table 1.

Table 1. Growth rate of *T. nilotica* fed with aquatic plants in floating cages (gram per day)

Feed	Time (week) of rearing				
	0-3	3-6	6-9	9-12	0-12
<i>Hydrilla verticillata</i>	0.71	0.09	0.33	0.76	0.44
<i>Lemna minor</i>	1.09	0.52	0.49	1.04	0.73
<i>Chara sp.</i>	0.83	0.28	0.13	0.85	0.43

Growth rate of the *T. nilotica* fed with *Lemna minor* was the fastest, while those fed with *Hydrilla verticillata* or with *Chara sp.* registered an almost equal rate. This indicates that *T. nilotica* prefers *Lemna minor* to the other two species.

According to some investigators (Bhatia, 1970; Blackburn and Sutton, 1971; Cross, 1969; Daskocil et al., 1973; Edwards 1974; and Fischer, 1968),

Lemna minor was one of the aquatic plants which could be easily consumed by herbivorous fish, especially by grass carp (*Ctenopharyngodon idella*).

Hydrilla verticillata and *Chara sp.* have a relatively "hard" structure compared with *Lemna minor* which had a relatively "soft" structure. The effect of those aquatic plants on the chemical composition of fish flesh is shown in following Table.

Table 2. Chemical composition of fish flesh of *T. nilotica* fed with aquatic plants

Feed	Composition of fish flesh (percent)			
	Water	Protein	Fat	Total
<i>Hydrilla verticillata</i>	82.29	13.64	3.50	99.43
<i>Lemna minor</i>	81.89	14.29	2.84	99.02
<i>Chara sp.</i>	83.84	12.19	2.86	98.89

Lemna minor gave the lowest water content and the highest protein content in the fish flesh of *T. nilotica*, while *Chara sp.* gave the highest water content and the lowest protein content. *Hydrilla verticillata* gave a "moderate" water content and protein content, but gave the highest fat content.

The chemical composition of the aquatic plants was not analyzed, so that a definite conclusion could not be drawn. From the data available (Table 2), only a rough relationship between aquatic plants given and composition of fish flesh could be described.

Feed conversion rate of aquatic plants is shown in Table 3.

Table 3. Conversion rate of aquatic plants as feed for *T. nilotica* in floating cages

Feed	Feed conversion rate
<i>Hydrilla verticillata</i>	23
<i>Lemna minor</i>	33
<i>Chara sp.</i>	19

Feed conversion rate of *Lemna minor* was the lowest (33 g of feed was needed to produce 1 g of fish flesh), *Hydrilla verticillata* was higher, while *Chara sp.* was the highest. Although the conversion rate of *Lemna minor* was low, the growth rate of fish was relatively faster because of high preference of the fish to this plant even with the highest stocking rate as shown in Table 4.

Table 4. Growth rate of *T. nilotica* fed with aquatic plants by the rate of stocking densities in floating cages (percent)

Feed	Rate of stocking (fish/cage)		
	5	15	45
<i>Hydrilla verticillata</i>	39.53	30.91	25.87
<i>Lemna minor</i>	58.42	50.78	41.66
<i>Chara sp.</i>	35.82	30.16	25.17

Growth rate of the fish was affected by the rate of stocking; the lower the density, the higher the growth rate. There was no interaction between feed and rate of stocking treatments.

As shown in Table 4, the rate of stocking level used in this experiment was relatively low as indicated by ratio of percentage of growth rate in every level of density; in other words the carrying capacity of the cage was not fully utilized. Further investigation to see the optimum density is needed.

Using aquatic plants as feed for cultured fish is recommendable since it may be useful for the control of aquatic weeds. But because of the low rate of conversion of the aquatic plants as feed, supplemental feed should be considered. The role of supplemental feeding in culturing *T. nilotica* either in pond or cage had been discussed by some authors (Guerrero, 1978a; Guerrero, 1978b; Guerrero, 1978c; Pagan, 1969).

In this experiment, the economic aspect of cage culture using aquatic plants as feed was not considered.

CONCLUSION AND RECOMMENDATIONS

1. Although the *Tilapia nilotica* is a microphagous omnivore, such aquatic plants as *Hydrilla verticillata*, *Lemna minor*, and *Chara sp.* could be given as supplemental food under cage culture condition.

2. *Lemna minor* as feed for *T. nilotica* could influence growth-rate of the fish, and gave the best effect compared with the other two aquatic plants.

3. *Lemna minor* gave the lowest water content and the highest protein content in the fish flesh of *T. nilotica*; *Chara sp.* gave the highest water content and the lowest protein content.

4. Conversion rate of *Lemna minor* was the lowest of the three, but it gave the best effect on growth rate at every level of stocking densities.

5. The use of aquatic plants as feed for *T. nilotica* could be proposed to be managed as small-scale industry based on cooperative activity of the people in the rural areas if it was possible to carry out the cage culture and where it is easy to culture such aquatic plants as *Lemna minor*.

6. Further investigation should be carried out to study the economic aspect of cage culture in which aquatic plants are used as main source of feed.

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